# A Test Stand to Characterize and Contribute to the Development of DEPFET X-ray Detectors

Completed Technology Project (2018 - 2021)

## Project Introduction

The field of X-ray astronomy is currently looking forward to several new missions (e.g Athena, BeppiColumbo, and IXPE which is a new SMEX polarimeter), and there is the possibility of a flag-ship mission (e.g. the Lynx X-ray Surveyor) and/or other SMEX through probe class missions in the long-term future with many mission concepts being developed (e.g. ARCUS). The X-ray detec-tors for these future missions must be developed to suitable maturity to be proposed for flight, and expertise operating the newest versions of the detectors must be acquired by potential mis-sion designers and proposers. There are several silicon X-ray imaging active pixel sensor (APS) detectors being developed at this time (hybrid CMOS, monolithic CMOS, and DEPFETs), and each of these have their own advantages and levels of maturity, while they all provide enhanced radia-tion hardness, lower power operation, and versatile readout modes. Of the new APS X-ray detec-tors being developed, the DEPleted p-channel Field Effect Transistors (DEPFETs) have exhibited the best noise performance to-date. While they do require larger pixel structures than their com-petitors, the low noise performance of these detectors makes them an excellent choice for many mission applications (e.g. they will be launched on 2 ESA missions, Athena & BepiColumbo), and their further development could benefit other missions, particularly future missions that might be led by NASA and US scientists. Up until now, the development of these detectors has been lim-ited to only two groups located in Germany; one group is at Max Planck Institute and the other is PNSensors which is comprised of engineers and scientists that previously led the DEPFET design work at Max Planck. We propose to engage one of these groups in order to: (a) acquire newly de-signed test DEPFET detectors built by PNSensor, through a very-low-cost arrangement, (b) build a test stand that can operate these detectors and gain valuable experience running them in vari-ous modes with variations on the detector settings, (c) characterize the DEPFETs independently of the manufacturer and in modes that are relevant to our x-ray applications, and (d) use this new operation experience and characterization data to inform the next design iterations and the op-timization of DEPFET detectors for future X-ray missions.

## Primary U.S. Work Locations and Key Partners

| Organizations Performing Work | Role | Type | Location |
|---|---|---|---|
| Penn State | Supporting Organization | Academia | University Park, Pennsylvania |


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## Table of Contents



## Organizational Responsibility

**Responsible Mission Directorate:**

Science Mission Directorate (SMD)

**Responsible Program:**

Astrophysics Research and Analysis

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## Project Management

**Program Director:**

Michael Garcia

**Program Manager:**

Dominic J Benford

**Principal Investigator:**

Abe Falcone

**Co-Investigators:**

Jenna Neff
David N Burrows

## Technology Areas

**Primary:**

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.1 Detectors and Focal Planes

## Target Destination

Outside the Solar System